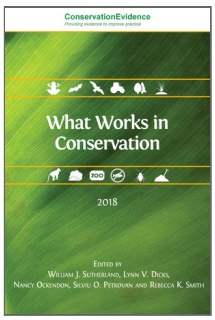

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9.2. Promoting health and welfare in captive carnivores (felids, canids and ursids) through feeding practices

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9.2 Promoting health and welfare in captive carnivores (felids, canids and ursids) through feeding practices

9.2.1 Diet and food type

Based on the collated evidence, what is the current assessment of the effectiveness of interventions for diet and food type?	
Likely to be beneficial	• Provide bones, hides or partial carcasses
Trade-off between benefit and harms	• Feed whole carcasses (with or without organs/ gastrointestinal tract)
Unknown effectiveness (limited evidence)	• Feed commercially prepared diets • Feed plant-derived protein • Supplement meat-based diets with prebiotic plant material to facilitate digestion • Supplement meat-based diet with amino acids
No evidence found (no assessment)	• Supplement meat-based diet with vitamins or minerals • Supplement meat-based diet with fatty acids • Increase variety of food items

Likely to be beneficial

Provide bones, hides or partial carcasses

One replicated, before-and-after study in the USA and one replicated, controlled study in Finland found that the provision of bones decreased the frequency of stereotypic behaviours in lions, tigers and Arctic foxes. Two replicated, before-and-after studies of felids and red foxes in the USA and Norway found that the provision of bones increased activity and manipulation time. *Assessment: likely to be beneficial (effectiveness 80%; certainty 60%; harms 0%).*

https://www.conservationevidence.com/actions/1902

Trade-off between benefit and harms

Feed whole carcasses (with or without organs/ gastrointestinal tract)

Two replicated, before-and-after studies in the USA found that feeding whole carcasses reduced pacing levels in lions, leopards, snow leopards and cougars. However, it increased pacing in tigers. One replicated, randomized, controlled study in Denmark found that when fed whole rabbit, cheetahs had lower blood protein urea, zinc and vitamin A levels compared to supplemented beef. One replicated before-and-after study in Denmark found that feeding whole rabbit showed lower levels of inflammatory bowel indicators in cheetahs. One replicated, randomized study and one controlled study in the USA found that when fed whole 1 to 3 day old chickens, ocelots had lower digestible energy and fat compared to a commercial diet and African wildcats had had lower organic matter digestibility compared to a ground-chicken diet. *Assessment: trade-offs between benefits and harms (effectiveness 80%; certainty 70%; harms 25%).*

https://www.conservationevidence.com/actions/1901

Unknown effectiveness (limited evidence)

Feed commercially prepared diets

One replicated, before-and-after study in the USA found that providing a commercial diet to maned wolves led to similar dry matter intake and digestibility despite having a lower protein content. One replicated, controlled study in South Africa found that cheetahs fed a commercial diet had a similar likelihood of developing gastritis as those fed horse meat, lower levels of blood protein urea but higher levels of creatine. One study in USA found that cheetahs fed a commercial meat diet or whole chicken carcasses had plasma a-tocopherol, retinol and taurine concentrations within the ranges recommended for domestic cats. *Assessment: unknown effectiveness (effectiveness 40%; certainty 35%; harms 50%).*

https://www.conservationevidence.com/actions/1900

Feed plant-derived protein

One replicated, randomized, controlled study and one replicated, controlled study in the USA found that a plant-derived protein diet increased digestible energy and dry matter digestibility but decreased mineral retention and plasma taurine levels in maned wolves compared to a (supplemented) animal-based protein diet. *Assessment: unknown effectiveness (effectiveness 10%; certainty 25%; harms 70%).*

https://www.conservationevidence.com/actions/1903

Supplement meat-based diets with prebiotic plant material to facilitate digestion

One replicated, before-and-after study in India found that providing Jerusalem artichoke as a supplement increased two types of gut microbiota, faecal scores and faecal moisture content in leopards. *Assessment: unknown effectiveness (effectiveness 50%; certainty 25%; harms 0%).*

https://www.conservationevidence.com/actions/1905

Supplement meat-based diet with amino acid

One replicated, before-and-after study in the USA found that supplementing an animal-protein diet with taurine, increased plasma taurine levels in

maned wolves. *Assessment: unknown effectiveness (effectiveness 90%; certainty 25%; harms 0%).*

https://www.conservationevidence.com/actions/1908

No evidence found (no assessment)

We have captured no evidence for the following interventions:

- Supplement meat-based diet with vitamins or minerals
- Supplement meat-based diet with fatty acids
- Increase variety of food items.

9.2.2 Food presentation and enrichment

Based on the collated evidence, what is the current assessment of the effectiveness of interventions for food presentation and enrichment?	
Beneficial	• Hide food around enclosure
Likely to be beneficial	• Present food frozen in ice • Present food inside objects (e.g. Boomer balls)
Trade-off between benefit and harms	• Provide devices to simulate live prey, including sounds, lures, pulleys and bungees
Unknown effectiveness (limited evidence)	• Change location of food around enclosure • Scatter food around enclosure • Provide live vertebrate prey • Provide live invertebrate prey
No evidence found (no assessment)	• Present food in/on water

Beneficial

● Hide food around enclosure

Four replicated, before-and-after studies in the USA, UK and Germany and one before-and-after study of a black bear, leopard cats, bush dogs, maned wolves and Malayan sun bears found that hiding food increased exploring and foraging behaviours. One replicated, before-and-after study and one before-and-after study in the USA found a decrease in stereotypical pacing

in leopard cats and black bear. One before-and-after study in the USA found that hiding food reduced the time Canadian lynx spent sleeping during the day. *Assessment: beneficial (effectiveness 90%; certainty 70%; harms 10%).*

https://www.conservationevidence.com/actions/1915

Likely to be beneficial

Present food frozen in ice

Two replicated, before-and-after studies in the USA found that when presented with food frozen in ice, abnormal or stereotypic behaviours decreased and activity levels increased in bears and felids. One replicated, before-and-after study in the USA found that manipulation behaviours increased in lions, whereas a replicated study in the USA found that manipulation behaviours decreased in grizzly bears. *Assessment: likely to be beneficial (effectiveness 70%; certainty 52%; harms 10%).*

https://www.conservationevidence.com/actions/1923

Present food inside objects (e.g. Boomer balls)

Two before-and-after studies in Germany and India found that exploratory and foraging behaviours increased and stereotypic behaviours decreased in sloth bears and spectacled bears when presented with food inside objects. One before-and-after study in the USA found that exploring/foraging behaviours decreased in a sloth bear when presented with food inside objects. One replicated study in the USA found that grizzly bears spent a similar time manipulating food in a box and freely available food. *Assessment: likely to be beneficial (effectiveness 60%; certainty 70%; harms 10%).*

https://www.conservationevidence.com/actions/1924

Trade-off between benefit and harms

Provide devices to simulate live prey, including sounds, lures, pulleys and bungees

Two before-and-after studies in the USA and the UK found that activity levels and behavioural diversity increased in felids when presented with a lure or pulley system. One replicated, before-and-after study in the USA found that pacing behaviour decreased and walking increased in cougars,

but pacing initially increased in tigers, when provided with a carcass on a bungee. *Assessment: trade-offs between benefits and harms (effectiveness 60%; certainty 50%; harms 25%).*

https://www.conservationevidence.com/actions/1927

Unknown effectiveness (limited evidence)

Change location of food around enclosure

One replicated, before-and-after study in Ireland found that altering the location of food decreased pacing behaviours in cheetahs. *Assessment: unknown effectiveness (effectiveness 90%; certainty 30%; harms 0%).*

https://www.conservationevidence.com/actions/1918

Scatter food around enclosure

One replicated, before-and-after study in Brazil found that scattered feeding increased locomotion in maned wolves. One replicated study in Brazil found that maned wolves spent more time in the section of their enclosure with scattered food than in a section with food on a tray. *Assessment: unknown effectiveness (effectiveness 70%; certainty 30%; harms 0%).*

https://www.conservationevidence.com/actions/1921

Provide live vertebrate prey

One small before-and-after study in the USA found that hunting behaviour increased and sleeping decreased when a fishing cat was provided with live fish. One replicated, before-and-after study in the USA found that there was no change in the occurrence of stereotypical behaviours in tigers when provided with live fish. *Assessment: unknown effectiveness (effectiveness 50%; certainty 30%; harms 0%).*

https://www.conservationevidence.com/actions/1925

Provide live invertebrate prey

One replicated study in the USA found that provision of live prey increased explorative behaviours in fennec foxes compared to other types of enrichment. *Assessment: unknown effectiveness (effectiveness 80%; certainty 20%; harms 0%).*

https://www.conservationevidence.com/actions/1926

No evidence found (no assessment)

We have captured no evidence for the following interventions:

- Present food in/on water
- Use food as a reward in animal training.

9.2.3 Feeding schedule

Based on the collated evidence, what is the current assessment of the effectiveness of interventions for feeding schedule?	
Trade-off between benefit and harms	● Provide food on a random temporal schedule
Unknown effectiveness (limited evidence)	● Allocate fast days
No evidence found (no assessment)	● Alter food abundance or type seasonally ● Provide food during natural active periods ● Use automated feeders ● Alter feeding schedule according to visitor activity ● Provide food during visitor experiences

Trade-off between benefit and harms

Provide food on a random temporal schedule

Three replicated, before-and-after studies and one replicated, controlled study found that an unpredictable feeding schedule reduced the frequency of stereotypic pacing behaviours in tigers and cheetahs. One replicated, before-and-after controlled study in the USA found that an unpredictable feeding schedule increased territorial behaviour in coyotes but did not affect travelling or foraging. One before-and-after study in Switzerland found that an unpredictable feeding schedule increased behavioural diversity in red foxes. *Assessment: trade-offs between benefits and harms (effectiveness 100%; certainty 80%; harms 20%).*

https://www.conservationevidence.com/actions/1904

Unknown effectiveness (limited evidence)

Allocate fast days

One replicated, before-and-after study in the UK found that large felids fed once every three days paced more frequently on non-feeding days. *Assessment: unknown effectiveness (effectiveness 6%; certainty 25%; harms 50%).*

https://www.conservationevidence.com/actions/1906

No evidence found (no assessment)

We have captured no evidence for the following interventions:

- Alter food abundance or type seasonally
- Provide food during natural active periods
- Use automated feeders
- Alter feeding schedule according to visitor activity
- Provide food during visitor experiences.

9.2.4 Social feeding

Based on the collated evidence, what is the current assessment of the effectiveness of interventions for social feeding?	
No evidence found (no assessment)	• Feed individuals separately • Feed individuals within a social group • Hand-feed

No evidence found (no assessment)

We have captured no evidence for the following interventions:

- Feed individuals separately
- Feed individuals within a social group
- Hand-feed.